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Is Radial Slab better than a Dorsal Slab in Maintaining Initial Reduction in Distal Radius Fractures?

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Abstract

Background: Displaced extra-articular fractures with dorsal comminution of distal radius are initially immobilised in a radial or a dorsal plaster slab after manipulation. The theoretical advantage of the radial slab is that it allows three point moulding. If reduction of the fracture is acceptable on radiograph, the plaster slab is changed to a full plaster cast, otherwise the fracture is either re-manipulated or a surgical intervention is undertaken. **Objectives:** The aim of this study was to assess if radial slab is better than the dorsal plaster slab in maintaining distal radius fracture reduction after initial manipulation. **Patients and Methods:** In this prospective comparative study of matched cohorts, patients with dorsally comminuted extra-articular fractures of distal radius were initially immobilised in either a dorsal or a radial slab following manipulation of the fracture. Antero- posterior and lateral radiographs were taken after fracture manipulation, and followed up at one week. Post manipulation radiographs were compared with radiographs at one week. **Results:** There were 49 patients in Group 1 (dorsal slab) and 47 patients in Group 2 (radial slab). The mean age of patients in Group 1 was 78 (71-95), compared to 74(72-89) in Group 2. There was statistically no significant difference in the radial height, radial inclination and volar tilt between groups. **Conclusion:** There is no difference between Radial and Dorsal slab in maintaining reduction in an extra-articular distal radius fracture.

Level of evidence: II

Keywords: Distal Radius Fracture, Radial slab, Dorsal slab, Fracture manipulation

Introduction

Fractures of the distal radius are common in both children and adults [1]. In the Western world, 6% of women by the age of 80 years, and 9% of women by the age of 90 years will have sustained this fracture [2]. These fractures are initially managed in the emergency department by application of a below elbow back slab with or without manipulation of the fracture. These fractures are treated non-operatively if the bone fragments can be held in anatomical alignment by a plaster cast. Plaster slabs applied are either dorsal slabs or radial slabs depending upon the expertise of the health care provider. However not all the staff involved in plaster application in emergency department have experience of radial slab application

as it involves three point moulding to maintain fracture reduction and to prevent displacement. While on the other hand, a dorsal slab is easy to apply after manipulation and the most common method of plaster slab in distal radius fractures in most centers. There is no published literature to support a preference for using either a dorsal or a radial back slab in the initial management of these fractures.

Extra-articular distal radius fractures are associated with significant healthcare burden, which may be reduced by maximizing the effectiveness of an adequate non-operative treatment [3]. The purpose of our study was to evaluate the effectiveness of two

types of casting techniques, by analyzing the radiological outcomes in patients. Our aim was to determine whether a radial slab is better than a dorsal slab in immobilizing extra-articular distal fractures with dorsal comminution.

Patients and Methods

We performed a prospective observational study of two matched cohorts to compare radial slab with a dorsal slab for maintaining reduction after manipulation of extra-articular fractures of distal radius. We did not have a protocol for application of a particular type of plaster slab in wrist fractures in our emergency department. Thus it was a normal practice in our emergency department to use both types of plaster slabs according to the operator expertise. In this manner, we selected matched cohort of patients in 2 groups of either receiving dorsal slab or radial slab and follow them up prospectively. A lower age limit of seventy was set to give us age-matched group of patients. Patients above the age of seventy, who presented acutely to the emergency department, with an extra-articular fracture with dorsal angulation, dorsal displacement, and dorsal comminution that required manipulation of the fracture, were enrolled in our study. All fractures with dorsal angulation beyond neutral, radial inclination of less than 15 degrees and radial height of less than 5 mm qualified for manipulation. None of these patients had dorsal comminution extending volar to the mid axial plane of radius. All patients had a low energy injury as a result of fall on outstretched hand. Patients with re-fracture, previous fracture in the same wrist, open fractures, and fractures with significant displacement needing operative intervention were excluded from this study.

The fractures were initially managed with closed manipulation under conscious sedation in the emergency department. An Orthopaedic Resident in the emergency department undertook fracture manipulation and a trained plaster technician applied a dorsal slab or a radial slab. A radial slab is a radially based gutter slab that encompasses four fifths of the circumference of the forearm. This leaves the ulnar side free to accommodate any post manipulation swelling. It extends from the distal palmar crease around the radial aspect of the wrist and proximally up to the proximal thirds of the forearm. A hole is cut out for the thumb. A dorsal slab extends from just proximal to the knuckles on the dorsum of the hand and proximally up to the proximal thirds of the forearm. Both types of plaster slabs were of good quality and applied by experience plaster technicians

to standardize the quality of plaster slab. All patients received a broad arm sling for comfort. Post manipulation antero-posterior and true lateral radiographs were taken to confirm the position of the fracture. At this stage we had two groups, Group 1 with a dorsal slab and Group 2 with a radial slab.

Patients in both groups were followed up at one week in a fracture clinic. The clinicians running the fracture clinics were not aware of any of these patients being in the study. At one week follow up, an antero-posterior and true lateral radiographs were taken through the plaster slab to determine whether the reduction had been maintained. All patients with maintenance of reduction had the plaster slabs changed to a full below elbow cast. They stayed in the below elbow cast for a period of five weeks, thus each wrist fracture had a total of six weeks immobilization, one week in either a dorsal or a radial slab and five weeks in a below elbow cast. There were no plaster related complications reported in either groups apart of loss of reduction of eight patients detailed in result section.

The immediate post-manipulation radiographs and radiographs at one week's follow up were assessed for measurement of radiological parameters e.g. radial height, radial inclination and volar tilt. Two Orthopaedic Registrars made the measurements with the mean used for analysis. The radiographs were viewed on high quality reporting screens of a Centricity Picture Archiving and Communication system (GE Healthcare, Chicago, Illinois, USA). The integral software was used for all measurements. We aimed to ascertain whether a radial slab was more effective than a dorsal slab in maintaining initial reduction. Statistical analysis was performed using Mann-Whitney U test and independent samples t test.

Results

A total of 96 patients enrolled in our study over one year period between August 2009 and July 2010. At one week follow up in fracture clinic, position of the fracture was found unacceptable in eight patients; five of these patients had re-manipulation of the fracture with plaster immobilization, whereas three patients had re-manipulation with Krirschner wire stabilization. All these patients had immobilization of their fractures for a total of six weeks. Three of these five patients had been placed in a radial slab after initial manipulation in emergency department.

There were forty-nine patients in Group 1 (dorsal slab) and forty-seven patients in Group 2 (radial slab). The mean age of patients in Group 1 was 78 (71-95),

compared to 74 (72-89) in Group 2. We had 43 females in Group 1 compared to 41 in Group 2 [Table 1]. The mean radiological parameters measured at the time of initial fracture manipulation, and at one week after immobilization in Group 1(dorsal) and Group 2 (radial slab) are described in Table 2.

	Group 1. Dorsal	Group 2. Radial slab
No. in group	49	47
Age (SD)	76.57 (6.46)	72.6 (10.55)
Range	70-94	72-98
Male/Female	6/43	6/41
Right/Left	38/11	31/16

Table 1: Demographic information

Radiological parameters	Group 1 Dorsal slab		Group 2 Radial slab	
	Week 0	Week 1	Week 0	Week 1
Radial height: Median, mm	8.99	7.86	11.43	10.86
Radial inclination: Mean, degrees	21.98	21.74	24.01	23.69
Volar/dorsal tilt: Mean, degrees	6.98	7.01	1.14	- 0.61

Table 2: Summary of results

Statistical Analysis

Radial height in mm

Calculated as difference in radial height (height at week 1 minus height at week zero) positive figure is a gain in height, negative is a loss of height. There was no statistically significant difference between those with a dorsal slab and those with a radial slab ($U = 1031$, $z = -0.89$, $p = 0.38$). This is illustrated in the box plot [Fig. 1].

Radial inclination in degrees

Calculated as difference in radial inclination (angle at week minus angle at week zero) positive figure represents a gain in inclination and negative figure represents a loss of inclination. There was no statistically significant difference in the change in radial inclination between the two groups ($t = 0.168$, $df = 94$, $p = 0.87$, two-tailed). Thus, it reduced slightly in each group. This is illustrated in the box plot [Fig. 2].

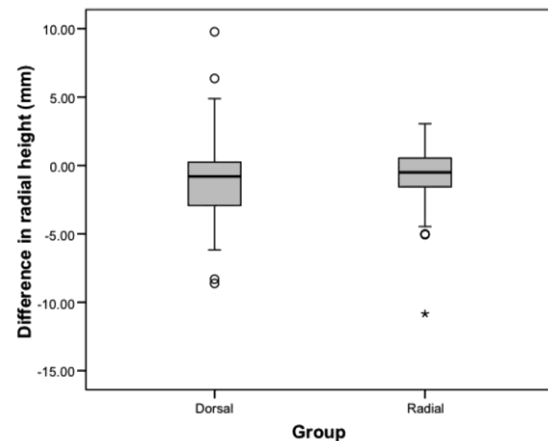


Fig. 1: Box plot showing difference in radial height at 1 week in a dorsal and a volar plaster slab.

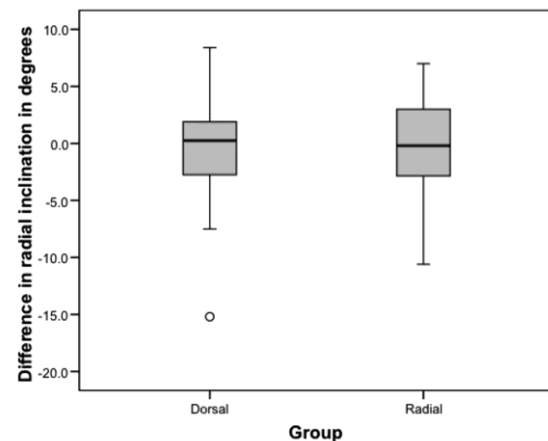


Fig. 2: Box plot showing difference in radial inclination at 1 week in a dorsal and a volar plaster slab.

Volar inclination in degrees

Calculated as the difference in volar inclination (angle at week 1 minus angle at week zero) positive figure represents a gain in angle and negative figure represents a loss. There was no statistically significant difference in the change in volar tilt between the two groups ($t = -0.059$, $df = 94$, $p = 0.95$, two-tailed). Thus, it tilted a little more dorsally after one week in each group. This is illustrated in the box plot [Fig. 3]. A summary of statistical analysis is reported in Table 3.

Discussion

Charnley (1950), famously advocated the use of radial slab rather than the dorsal slab for Colles' fractures.

However, there is no published study in the current literature, which compares the two techniques of plaster application [10]. The purpose of this study was to establish whether a radial slab is better than a dorsal slab in maintaining reduced position in extra articular distal radius fracture with dorsal comminution.

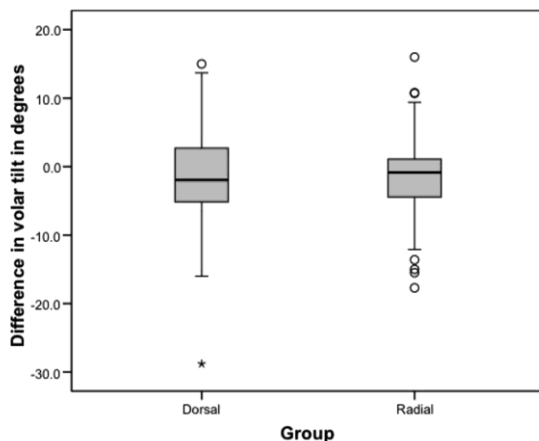


Fig. 3: Box plot showing difference in volar tilt at 1 week in a dorsal and a volar plaster slab.

	Group 1 Dorsal slab	Group 2 Radial slab	Statistical test
Radial height, median Week 1 - Week 0	- 0.80 mm	- 0.50 mm	Mann Whitney U P = 0.38
Radial inclination, mean Week 1 - Week 0	- 0.24 degrees	- 0.38 degrees	Independent samples t test P = 0.87
Volar inclination, mean Week 1 - Week 0	-1.62 degrees	-1.53 degrees	Independent samples t test P = 0.95

Table 3: Summary of statistical tests between groups

Distal radius fractures are common in elderly, and lead to morbidity and loss of quality of life [9]. A recent multi-center study in the United Kingdom, of patients aged 35 years and above with Colles' fracture reported an annual incidence of 9/10,000 in men and 37/10,000 in women [8]. Young adults usually sustain this injury as a result of high-energy trauma. In older adults, especially females, the fracture more often results from low-energy or moderate trauma. This reflects the greater fragility of the bone,

resulting from disuse or postmenopausal osteoporosis [8]. Fractures of distal radius in which the bone fragments are undisplaced or can be held in anatomic alignment by a plaster cast are treated non-operatively [4]. Fractures that do not redisplace in a cast in the first 10 days after reduction are treated non-operatively with good functional results [6]. Non-operative treatment is more challenging, as the patient needs to be closely followed up and monitored with serial x-ray imaging to watch for displacement and requires re-manipulation or operative fixation [3]. It is unclear whether surgical intervention of most fracture types produces better long term results compared to non-surgical treatment [5]. Closed reduction and cast immobilization is still a frequently used mode of treatment. Although there is a general agreement that anatomical outcome of plaster cast immobilization is determined by the fracture stability, there is no literature to support a preference for using either a dorsal or a radial slab in the initial management.

After initial fracture manipulation and immobilization in a plaster slab, the fracture is reviewed later and assessed radiologically to ascertain maintenance of position. To maintain an adequate reduction, it is important to adhere to the three point casting technique described by Charnley [10]. This implies application of two points of contact proximally and distally to the fracture on the concave side of initial fracture angulation, and a counterpoint contact at the fracture level on the convex side of initial angulation. In unstable fractures, where fracture reduction can't be maintained with cast immobilization, additional fixation is suggested [7]. Having reduced the fracture, the initial immobilization can be done using a sugar tong splint, a back slab or a radial slab. A sugar tong splint has the advantage of maintaining the position of pronation or supination [3]. The radial slab has a theoretical advantage over the commonly used dorsal slab (back slab), as it allows three point moulding to help prevent displacement and angulation. For this to be effective it must reach the midline of the forearm on the volar aspect, and should be thick enough to take a permanent impression from the surgeon's thenar eminence while the plaster is setting [10]. For the first week, the plaster slab is maintained and follow up radiographs are performed at 7 days following the reduction. At 7 days the plaster slab is changed to a short forearm cast. These follow ups allow recognition of loss of reduction, and decisions are made about further interventions if the fracture reduction is unacceptable.

In our study, we had some loss of radial height, radial inclination and volar tilt in both groups of patients. The results showed no difference in this loss of radiological parameters between the two groups of radial and dorsal plaster slabs.

A limitation of our study is that we examined only patients aged above 70, and we did not look at other distal radius fracture patterns. Thus we are not certain that our results can be generalized to other distal radius fracture patterns. A randomized control study will be required to definitively confirm if there is a difference between a radial and a dorsal slab. Given the significant healthcare burden resulting from wrist fractures, establishing an effective initial immobilization method could help reduce the costs. Results of statistical analysis from our study revealed that there is no statistically significant difference between radial and dorsal slab in the initial treatment of extra articular distal radius fractures. To our knowledge, this is the first study to examine the effects of a radial and a dorsal slab in maintaining fracture reduction.

Conflict of interest

None

Acknowledgement

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